ARPA-E: Launching Energy Innovation in the 21st Century

Arun Majumdar, Director

Eric Toone, Deputy Director for Technology

Shane Kosinski, Deputy Director for Operations

Energy Innovation Summit

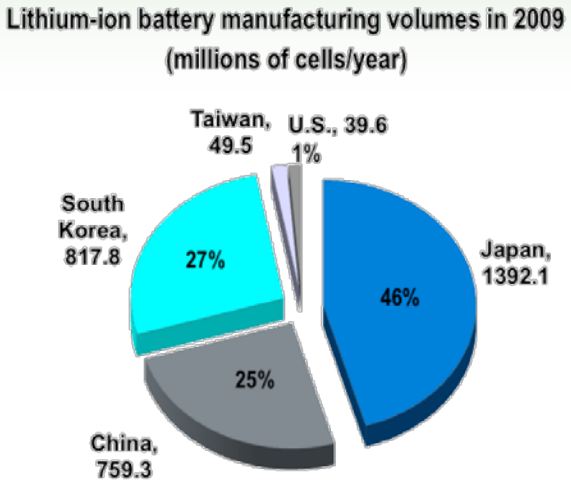
February 28, 2011

Background

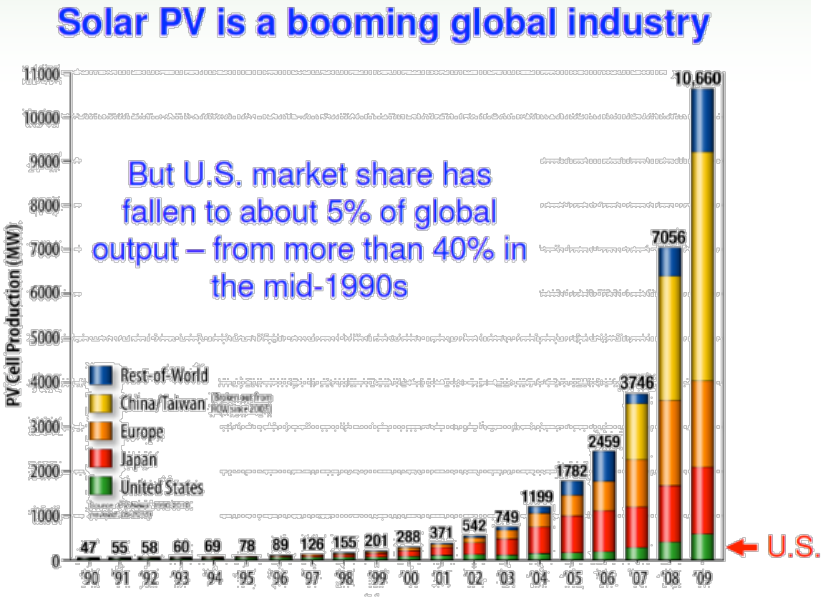
Projects

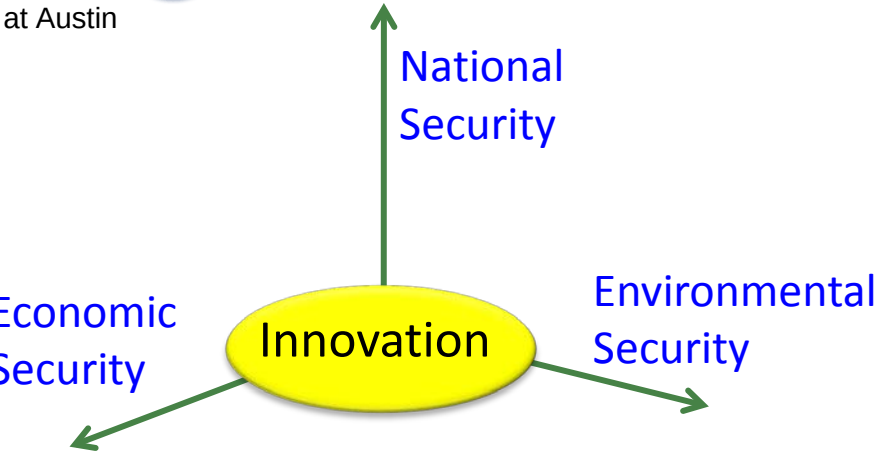
Process

Wake Up Call

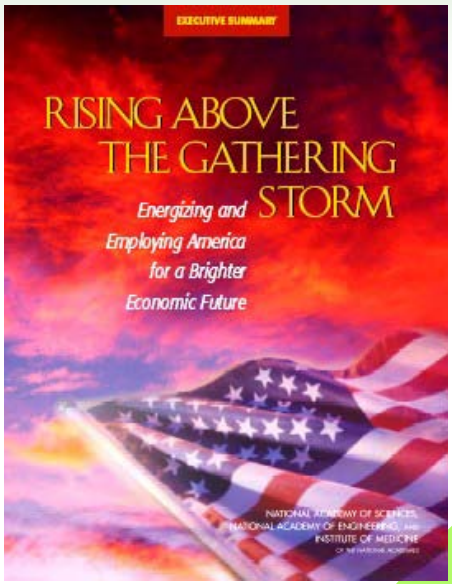


THE ENRICO FERMI AWARD
2009
John Goodenough, U. Texas at Austin





Creation & Launching of ARPA-E



2009
American Recovery and Reinvestment Act
($400M appropriated for ARPA-E)

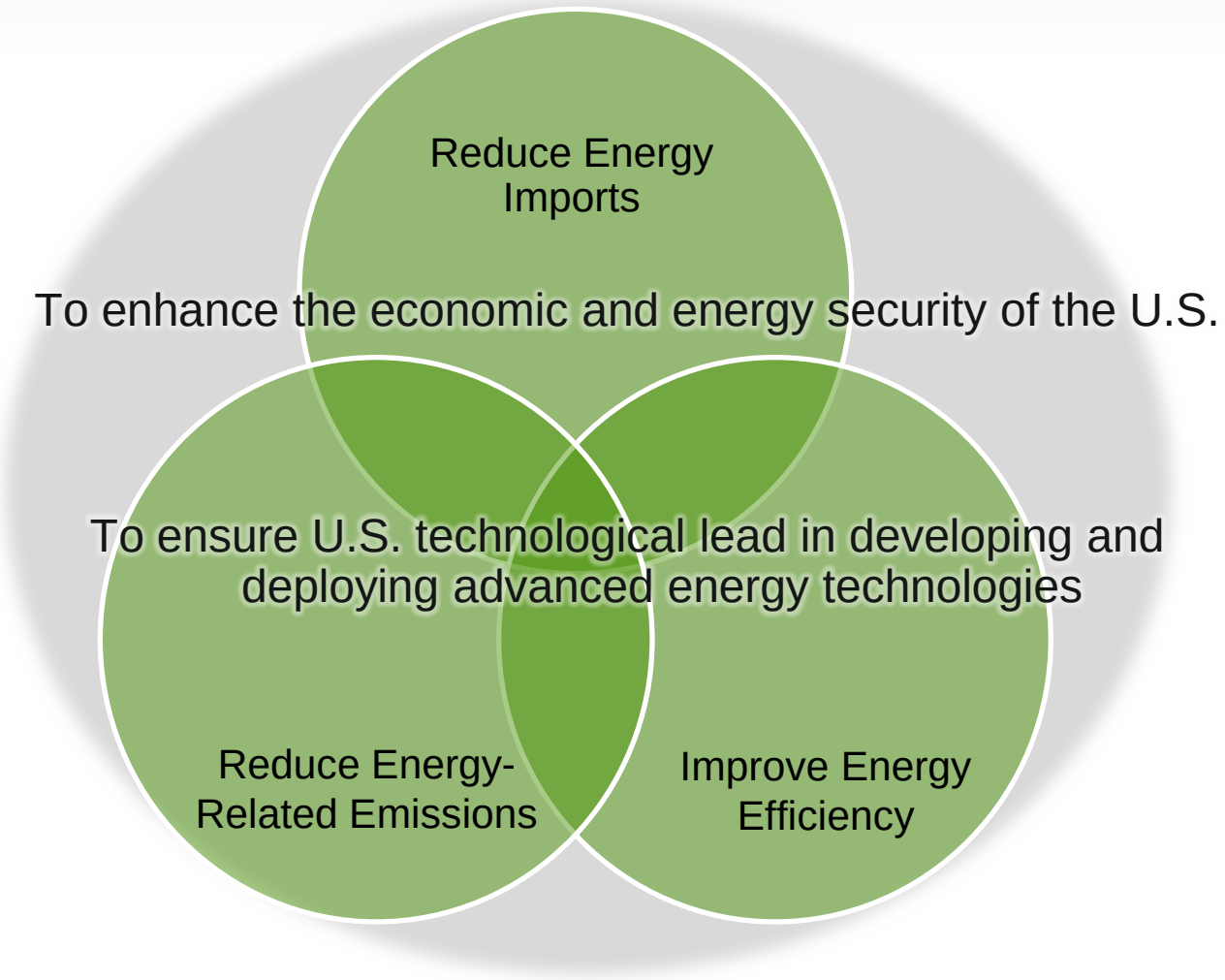
2007
America COMPETES Act

2006
Rising Above the Gathering Storm
(National Academies)

President Obama launches ARPA-E at National Academies on April 27, 2009

Innovation based on science and engineering will be primary driver of our future prosperity & security

ARPA-E's Mission and Means



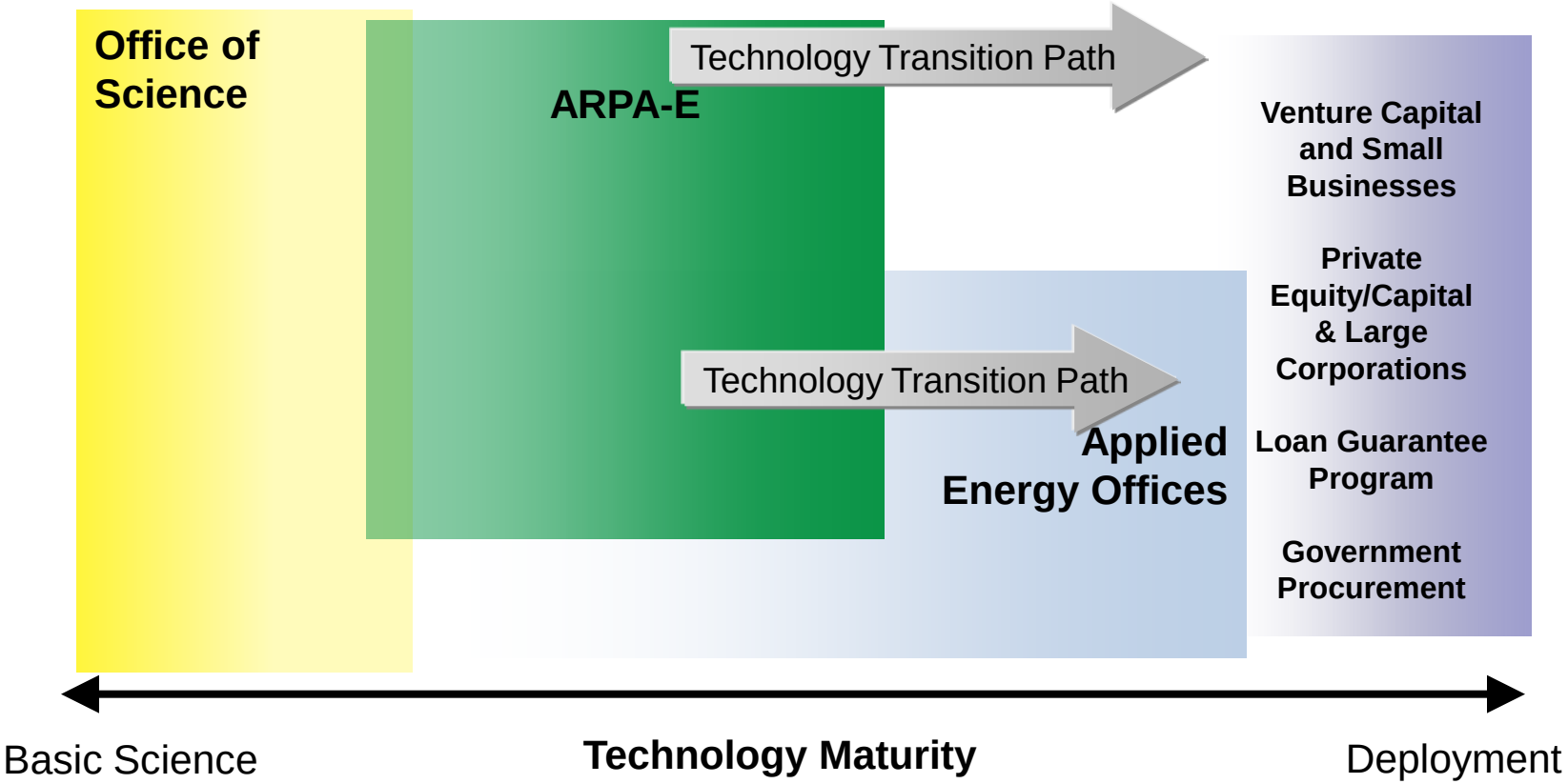
To overcome the long-term and high-risk technological barriers in the development of energy technologies.

(A) identifying and promoting revolutionary advances in fundamental sciences; **AND**

(B) translating scientific discoveries and cutting-edge inventions into technological innovations; **AND**

(C) accelerating transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty.

Energy Innovation Pipeline



Dr. Arun Majumdar
ARPA-E Director

(MechE/Matl Sci, UCB/LBL)

(Econ, Albany)

Shane Kosinski
Deputy Director of Operations

Dr. Eric Toone
Deputy Director of Technology

(Chemistry, Duke)

Operations Team

Matt Dunne (JD, Georgetown)
Acting Chief Counsel
Michael Saretsky (JD, GWU)
Christina England (JD, Vanderbilt)

John Harris
Patricia Espinoza
Contracting Officers

Antony DiGiovanni (U. Mich)
Budget Officer
Eli Levine (JD, Wash. U St. Louis)

Commercialization & Strategic Outreach Teams

Commercialization:
Sanjay Wagle (Harvard/UCB)
Dr. Srinivas Mirmira (TAMU/Chicago)
Leshika Samarsinghe (Stanford/Harvard)

Strategic Outreach:
Peder Maarberg
Shannon Barrett

Program Team

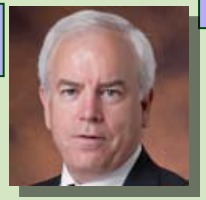
ARPA-E Fellows
Dr. Karma Sawyer (Chem, UCB)
Dr. Nicholas Cizek (Phys, Stanford)
Dr. Robert Conrado (Chem E, Cornell)

Dr. Dave Danielson

(Matl Sci, MIT, Gen. Cat.)

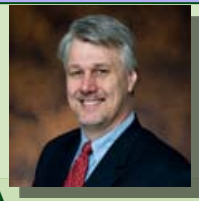
Dr. Eric Toone

Dr. Mark Hartney



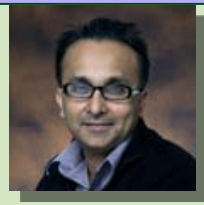
(Chem E, DARPA, FlexTech)

Dr. Mark Johnson



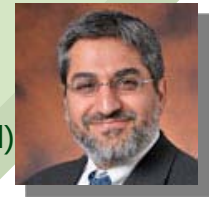
(Matl Sci, NCSU)

Dr. Ravi Prasher



(MechE, ASU, Intel)

Dr. Rajeev Ram



(EECS, MIT)

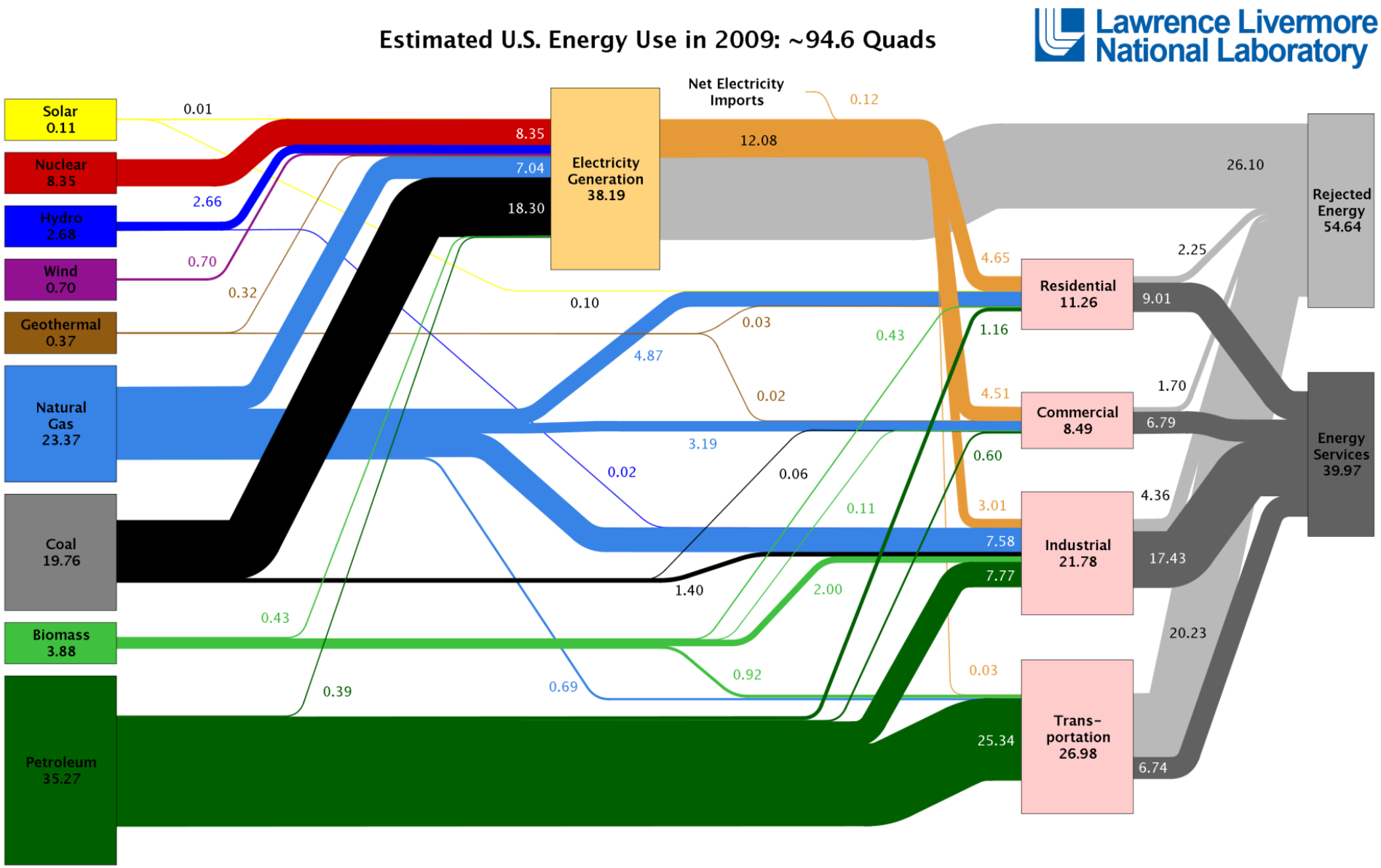
Dr. Jonathan Burbaum

(Biochem, Merck, Pharmacopeia)

Dr. David Shum

(MechE, Harvard, St. Gobain

Rewiring the U.S. Energy Diagram



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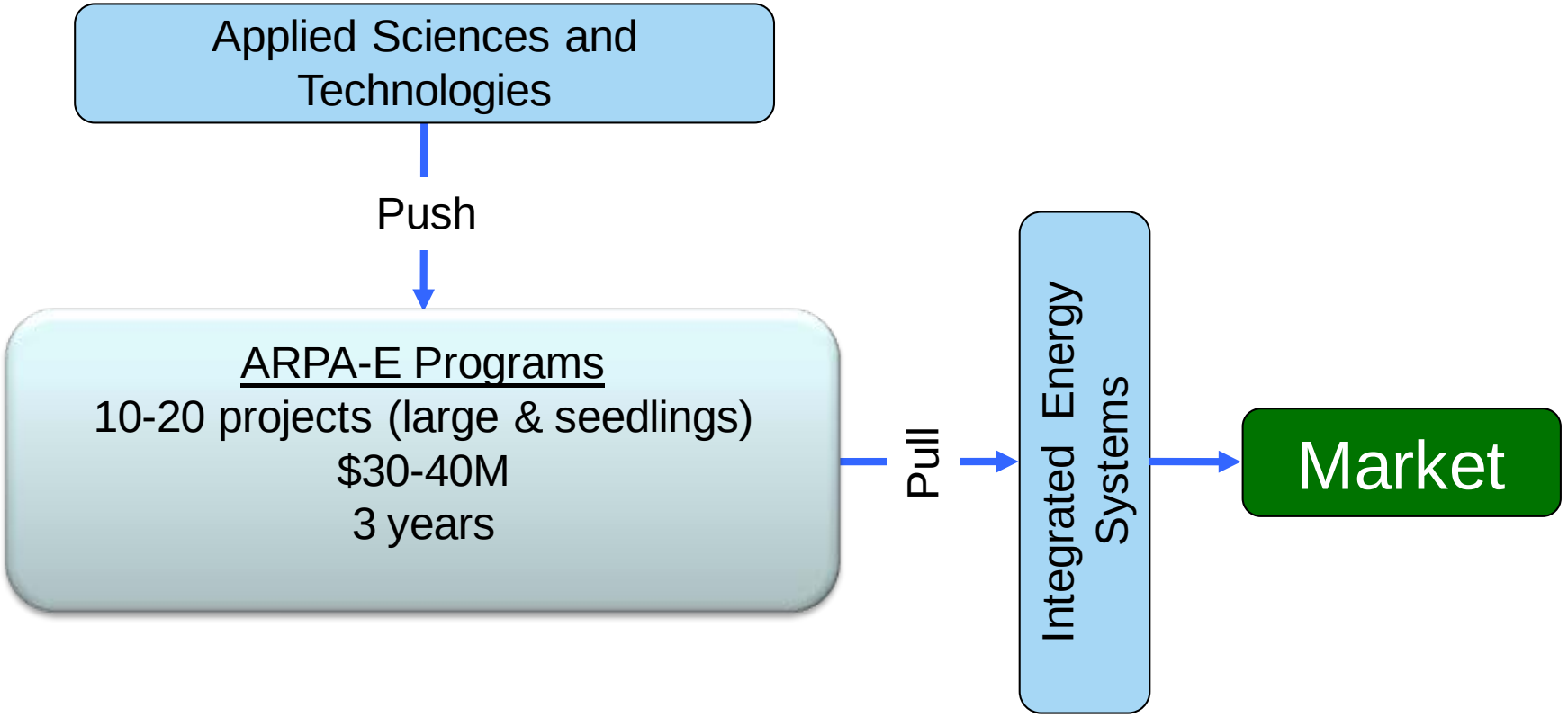
ARPA-E programs foster technology push and market pull to accelerate transformational energy technologies



An ARPA-E Project has four main attributes

IMPACT

If successful, project could have:

- High impact on ARPA-E mission areas
- Large commercial application

BREAKTHROUGH TECHNOLOGY

Technologies that:

- Do not exist in today's energy market
- Are not just incremental improvements; could make today's technologies obsolete

ADDITIONALITY

- Difficult to move forward without ARPA-E funding
- But able to attract cost share and follow-on funding
- Not already being researched or funded by others

PEOPLE

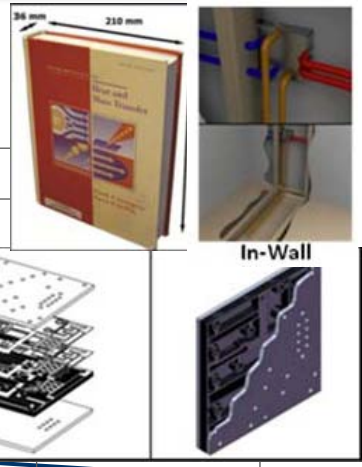
- Best-in-class people
- Teams with both scientists and engineers
- Brings new people, talent and skill sets to energy R&D

Building Energy Efficiency Through Integrated Thermodevices (BEETIT)

Dr. Ravi Prasher

Building cooling is responsible for ~5% of US primary energy consumption and CO_2 emissions

Small Footprint Modular Absorption Cooling



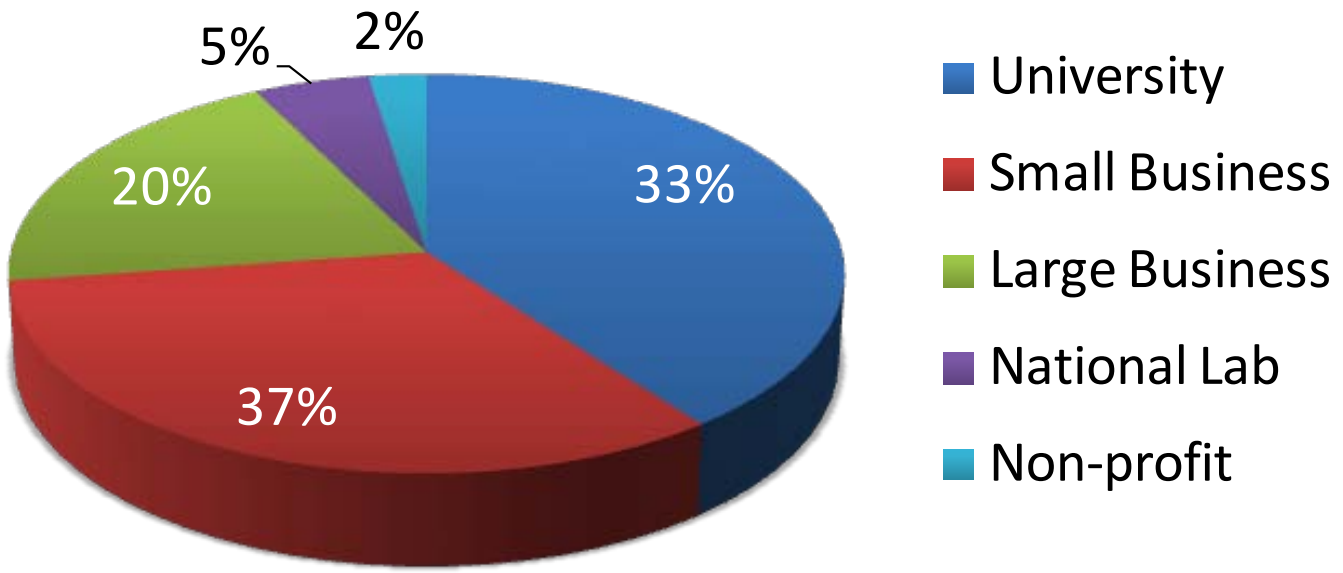
T_{amb} = 90 °F, RH = 0.9
T_{supply} = 55 °F, RH = 0.5

Source: Velders et al, PNAS 106, 10949 (2009)

Reduce primary energy consumption by ~ 40 – 50%

To date ARPA-E has made 121 awards from seven FOAs to a wide variety of organizations

Project Breakdown by Lead Organization Type (% based on award value)*



*Total Value of Awards = $366 million

ARPA-E Currently has six focused programs plus a broad portfolio of projects from its first solicitation

Broad Solicitation

Transportation

Electrofuels

BEEST

End-Use Efficiency

BEETIT

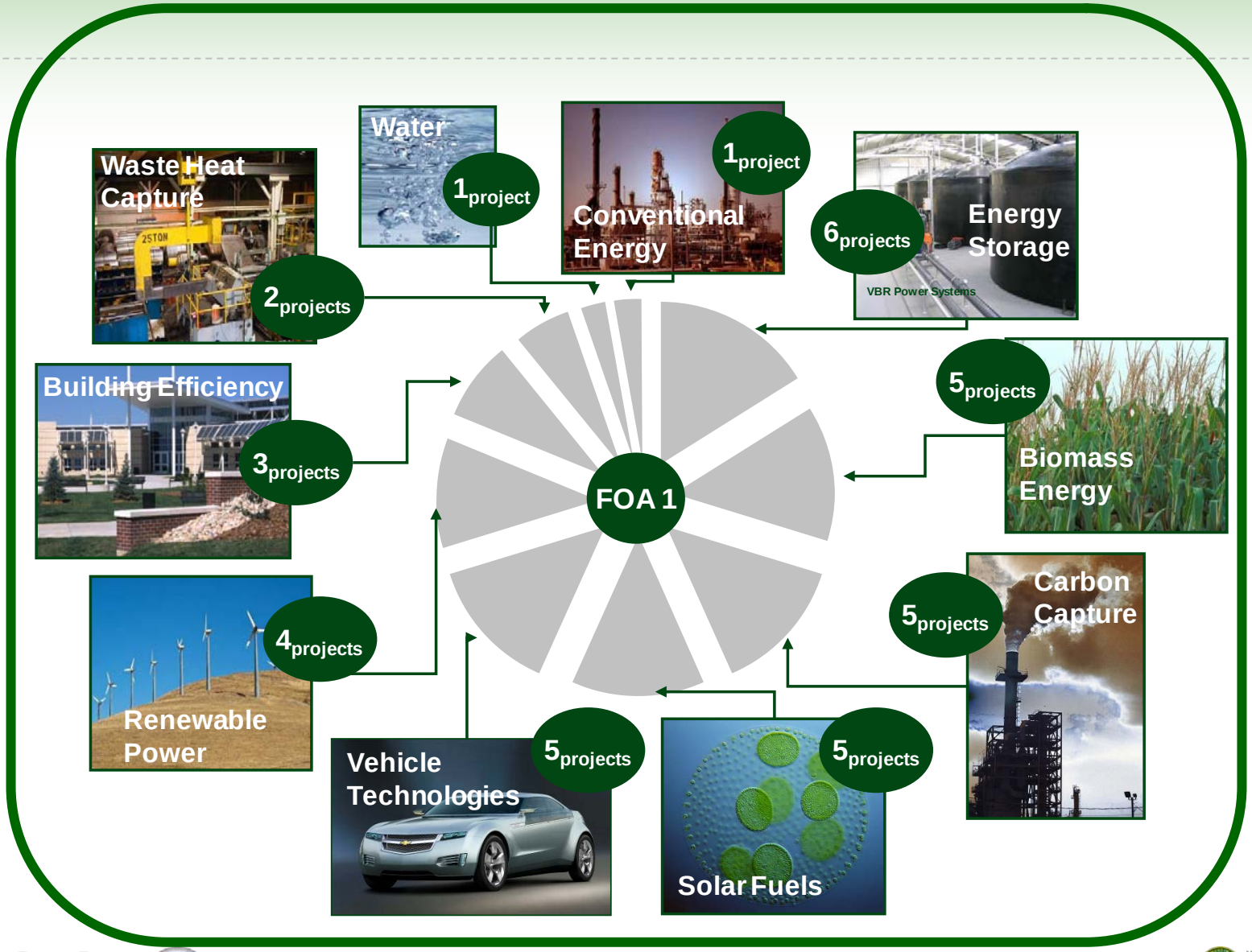
Stationary Power

ADEPT

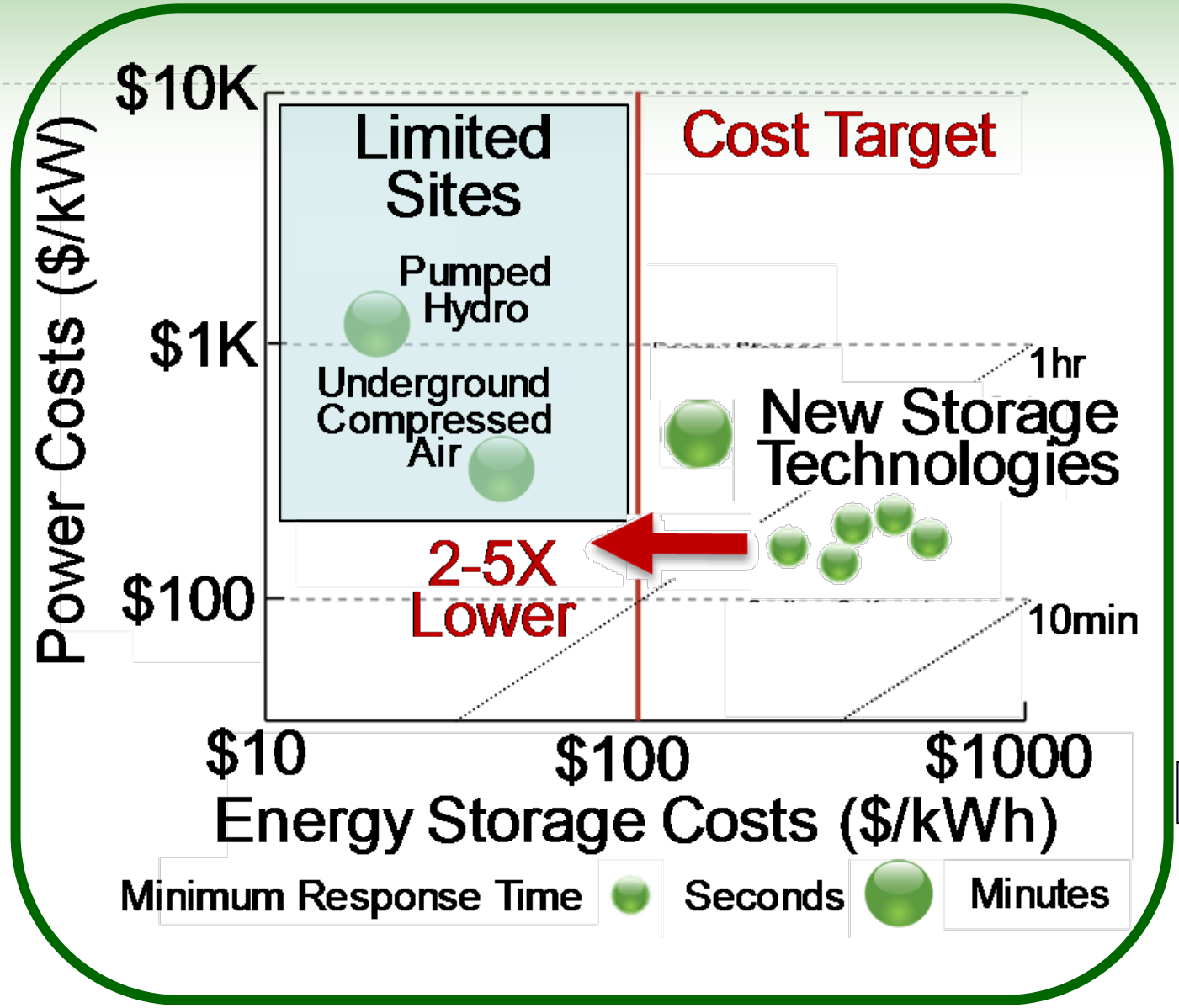
IMPACCT

GRIDS

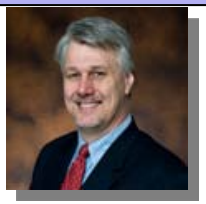
FOA1


Water
1project
Waste Heat Capture
2projects
Conventional Energy
1project
6projects
Energy Storage
VBR Power Systems
Building Efficiency
3projects
FOA 1
5projects
Biomass Energy
4projects
Renewable Power
5projects
Carbon Capture
Vehicle Technologies
5projects
5projects
Solar Fuels

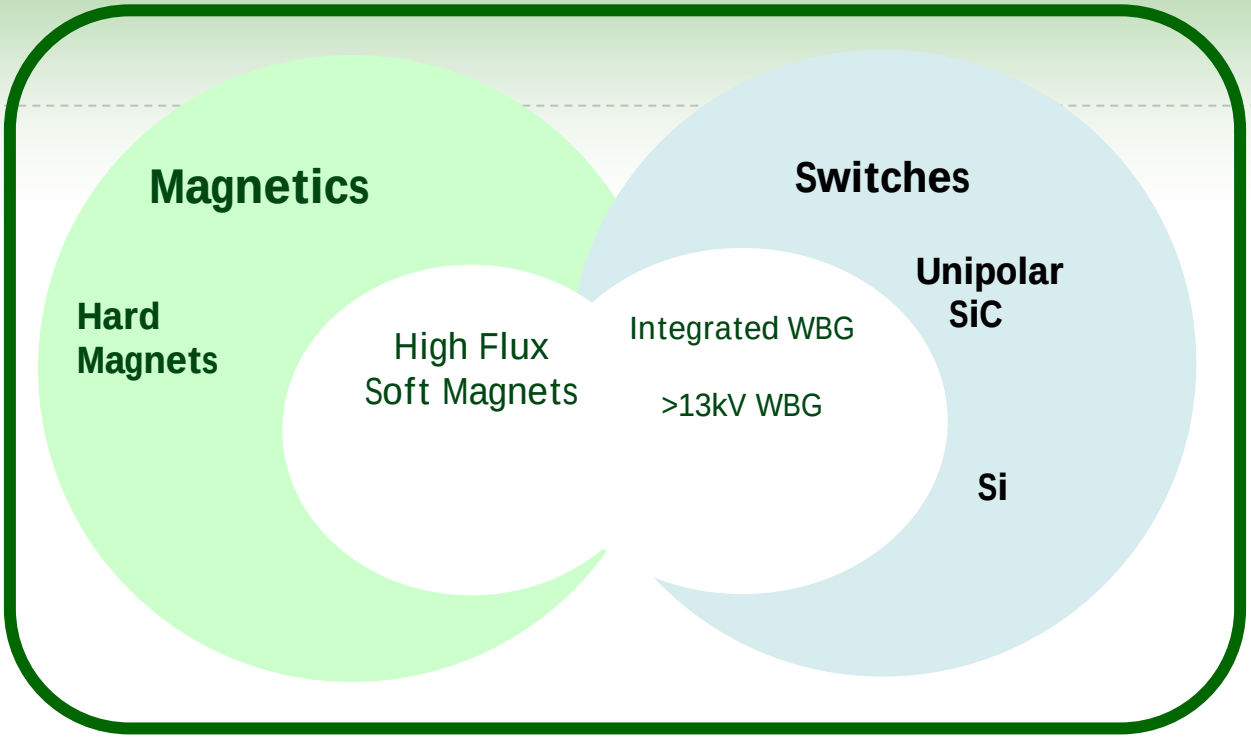
GRIDS



Dr. Mark Johnson



ADEPT



Integrated Circuits for Power Systems

- On-chip inductors and transformers
- High-voltage transistors
- High-energy capacitors

Dr. Rajeev Ram

Background

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Process

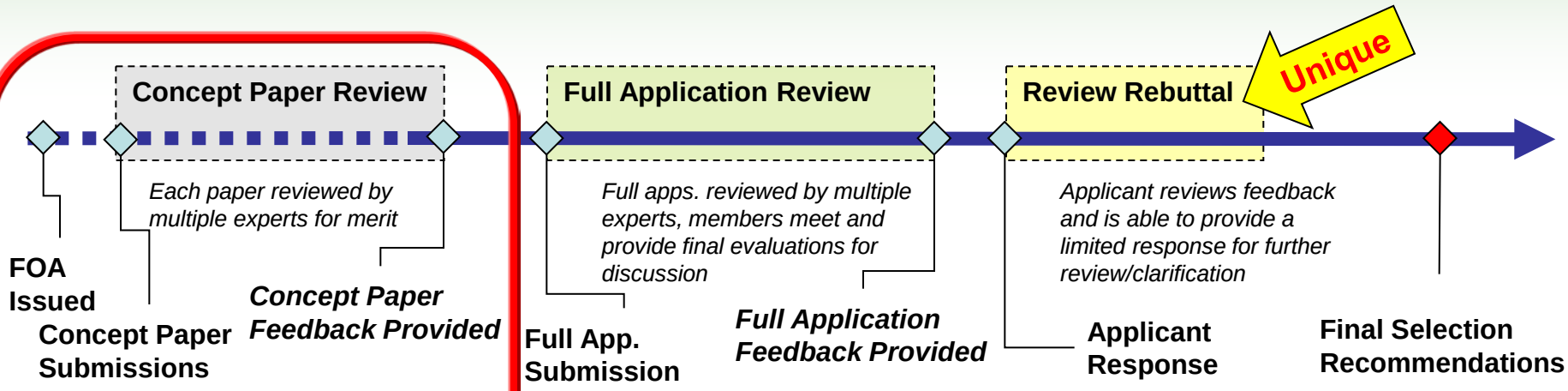
ARPA-E's program development process is extremely fast – only 6-8 months from conception to execution

Program Development Cycle

From Program Conception to Execution in 6-8 Months

ARPA-E's program creation process starts internally but receives outside input through a workshop

The Funding Opportunity Announcement (FOA) process is fast-paced, but deliberative



- 5-7 page summary
- Limits applicant expenses
- Reviewer comments provided to applicants

- Review by external, leading experts in the field
- External reviews critical to decision making – but scores do not get rack and stacked

- Applicants respond to reviews before selections
- Clarification improves final decisions

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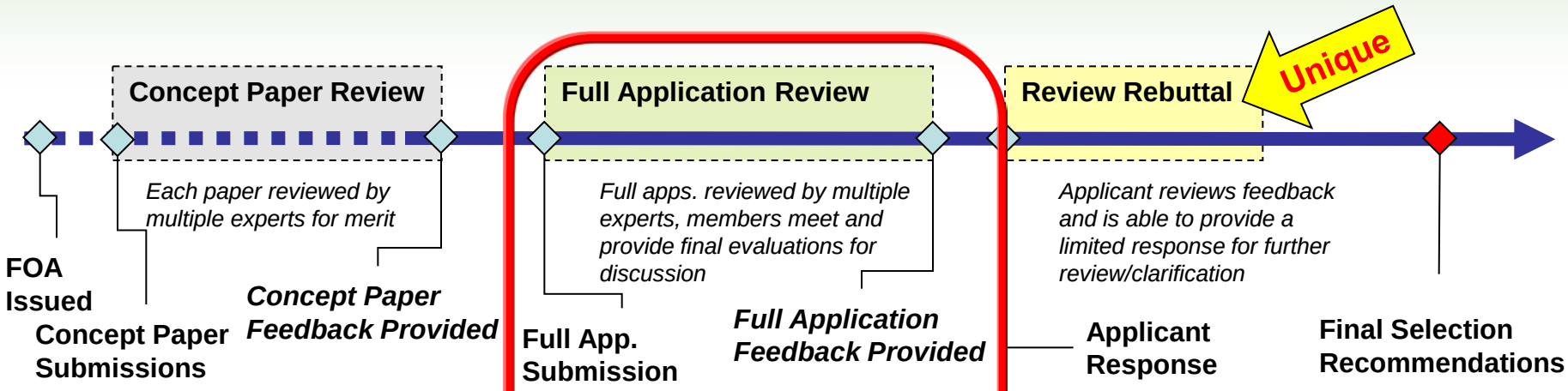

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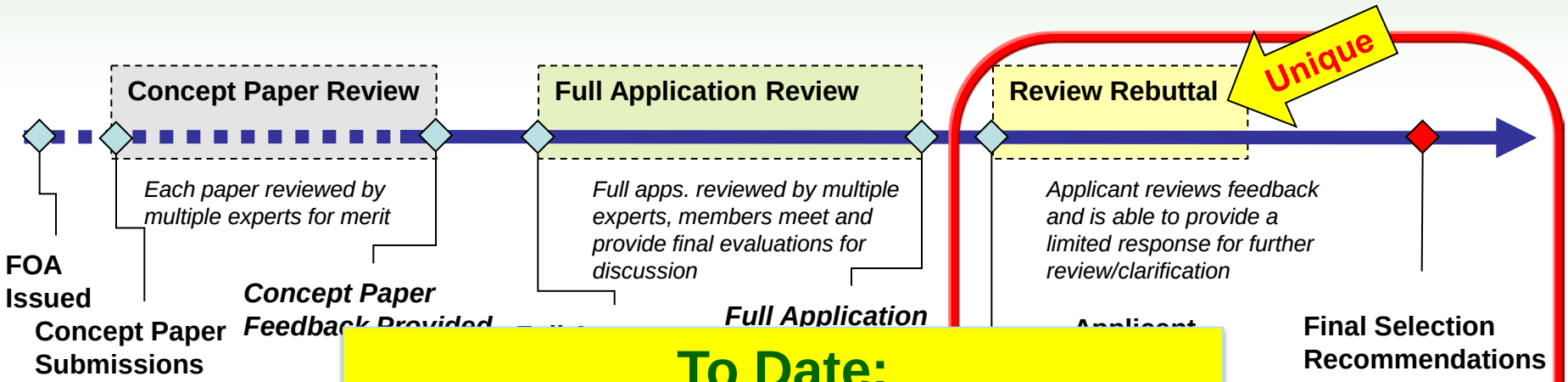

To Date:
6 Focused Programs
1 Broad Funding Announcement
Over 5,000 Applications
120 Projects

- 5-7 page summ
- Limits applicant expenses
- Reviewer comments provided to applicants

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A streamlined contract negotiation and award process allows projects to begin promptly

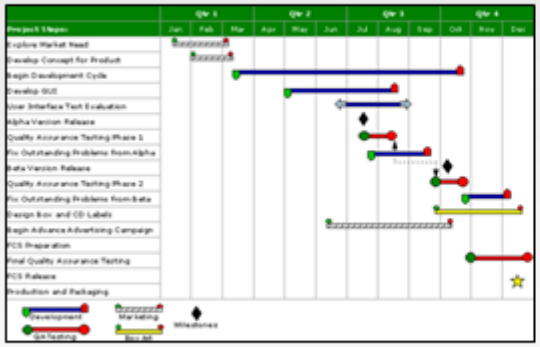
- Aggressive internal and external deadlines established – move at the pace of business
- ARPA-E Technical, Contracting and Legal teams co-located – limits bureaucracy
- ARPA-E developed user-friendly negotiation guide and materials provided
- Jointly develop challenging technical milestones

"ARPA-E has consistently impressed and surprised us with the speed of their evaluation and contracting process, and the high caliber of their staff…We wish all R&D programs could adopt this degree of efficiency and professionalism" – ARPA-E Performer

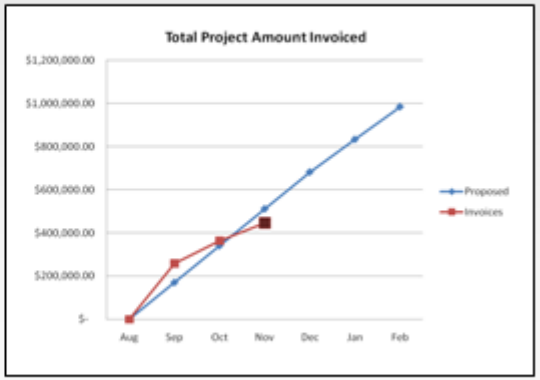
ARPA-E's active program management promotes eventual project success

Program Management Tools

SCHEDULE



COST



TECHNICAL NOTES

Task 1: Chip Fabrication			
	Subtask	*Milestone*	*Technical Notes*
	1.1: Deposit high capacitance materials	Q3: 20 microfarad capacitance achieved on 45 cm^2 sample	Best capacitance to-date is 12 μF; new oxide material was proposed at last meeting to achieve target
	1.2: Improve etch performance	Q4: New etching tool installed	On-track: PO made last week, delivery set for Nov.

Active Program Management

- ARPA-E has a vested interest in the success of the project, we do not just provide a check
- Regular contact – at least two site visits per year, and formal quarterly reviews
- Help identify and resolve technical issues
- Annual community meetings

Questions

Pre-Conference Workshop - Agenda

10:05 AM	**Breakout Sessions: ARPA-E Future Technology Workshops**
	Sunshot
	Rare Earth and Critical Materials Technologies
	High Density Thermal Energy Storage
10:55 AM	**Breakout Sessions: ARPA-E Future Technology Workshops**
	Applied Biotechnology for Transportation Fuels
	Green Electricity Network Integration (GENI)
11:40 AM	**Networking Lunch**
12:40 PM	**Breakout Sessions: Technology Town Halls**
	The Energy-Water Nexus
	Natural Gas to Liquid Fuels
1:35 PM	**Building Strategic Partnerships**
3:00 PM	**Breakout Panels**
	Venture Capital Funding: Prospecting in a Constrained Environment
	Technology Launch: From Universities and National Labs to the Marketplace
4:00 PM	**The Government Role in Energy R&D -- followed by Focused Networking Session with Funding Programs**
5:30 PM	**Technology Showcase and Reception**

Open to All Registered Attendees - Showcase closes at 8:00pm